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FARM BUTTER MAKING.

BY

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., April 25, 1913.

SIR: I have the honor to transmit herewith for publication as a Farmers' Bulletin a paper on "Farm Butter Making," by Mr. J. R. Keithley, junior dairyman in the dairy division of this bureau. This paper is intended to replace Farmers' Bulletin 241, "Butter Making on the Farm," issued in 1905.

Respectfully,

A. D. MELVIN,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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FARM BUTTER MAKING.

The amount of farm butter, according to the census reports of 1890 and 1900, was in excess of 1,000,000,000 pounds annually. In 1909 it was 994,650,610 pounds. That a large part of this is of poor quality is generally known, but on account of the widely scattered, isolated condition of the farm butter makers it is a difficult problem to take steps which would result in an improvement. If this improvement is to take place and prove of profit to the farm butter makers it is very necessary that greater attention be given to details concerning the factors affecting the quality of butter.

The fundamental facts and practices concerning butter making should be applied by the farmer as well as the creamery operator. This knowledge and its importance should be known in order that it can be intelligently applied. Cleanliness and attention to details are the two prerequisites to the manufacture of good butter. The main defects in farm butter show these two prerequisites to be very frequently neglected. These defects are:

(1) Bad flavors.
(2) Lack of uniformity in color and salt.
(3) Unsuitable packages and no uniformity in the style of the packages.

The bad flavors are due largely or entirely to the changes in the milk and cream before it is churned rather than to the subsequent treatment of the butter.

CAUSE OF CHANGE IN MILK AND CREAM.

The change in milk and cream is due largely to the action of microorganisms known as bacteria upon the various constituents of milk.

Normal milk is composed of the following:

	Per cent.		Per cent.
Water	87.17	Albumin	0.53
Butter fat	3.69	Sugar	4.88
Casein	3.02	Ash	.71

The constituents which the bacteria act upon are the milk sugar, albumin, and casein. Their action upon the milk sugar results in the formation of a sour, acid by-product which causes what is gen-

erally known as sour or curdled milk. Their action upon the casein and albumin results in the formation of by-products of various peculiar flavors and aromas which may or may not be objectionable. The butter fat, which is affected only slightly, if at all, by the bacteria, very quickly absorbs any flavors or aromas which may result from the bacterial action upon the casein, albumin, or sugar.

The presence of bacteria in milk is dependent upon external conditions and agencies. Milk, when drawn from the udder of a healthy normal cow, contains bacteria in comparatively small numbers. Those which get in later must do so through the agency of some carrier, such as dust, dirt, filth, and manure from the atmosphere, hands and clothing of the milkers, or from the body of the cow. The exclusion of the most objectionable kinds of bacteria is simply a matter of cleanliness about the barn, milk room, or any other place where milk is handled and requires that attention be given to details. The bacteria, however, which do get into milk increase in number very rapidly, due ordinarily to the favorable warm temperature and the presence of desirable food, i. e., milk sugar, casein, and albumin. Their increase depends primarily upon the temperature. If it is low (50° to 40° F.), a very slow increase occurs; if higher (75° to 100°), a much more rapid increase occurs. This increase or growth results in the breaking up of some of the milk sugar, casein, and albumin, with the formation of by-products as mentioned above. That the quantity and quality of these by-products depends upon the kind of bacteria present and their growth should be constantly kept in mind and all practical efforts made to exclude the bacteria and control their growth.

CLEANLINESS.

The importance of cleanliness can not be overemphasized. In our haste to accomplish a task we often sacrifice our better judgment, only to learn that haste at that stage of the work necessitates a waste in time and labor at a later period. This is particularly true in handling milk and cream that is to be used in the manufacture of butter on farms. The bodies of the cows, the utensils, and the conditions at the barn, the milk room, and storage room should all be clean. These are the primary factors which affect the cleanness of milk and cream.

BODY OF COW.

The body of the cow should be kept clean. There probably is no greater source of contamination to milk than that of dust, hairs, manure, or excreta falling from the body of the cow into the open milk pail during milking. The types of bacteria which are found

associated with this filth are capable of producing very objectionable changes in milk and its products. Their activity is greatly increased by the favorable conditions which, we have noted, exist in warm milk. Anything which tends to favor this accumulation of filth on the cow's body should be removed and the cow kept clean, particularly about the flanks and udder. This can be done very efficiently and easily by keeping the long hairs clipped from the flanks and by wiping the udder with a moist cloth or sponge. The clipping of the flanks keeps the hair short and does not favor the accumulation or retention of filth. That which does adhere can be more quickly and easily removed with a currycomb and brush than if the hair were long and had the manure worked into it sufficiently to form a more or less filthy mat. In addition to keeping the cow's body, especially during milking, free from dust and filth the barn should be free from dust and well ventilated. The feeding of hay or any other feed stuff just preceding milking, which will leave the atmosphere of the barn full of dust, should be avoided. Sufficient time should be allowed between the addition of feed to the feed boxes and the time of milking to permit the dust to settle. In many large dairies this is hastened by use of fine spray or mist, which soon clears the atmosphere of dust. It is well to bear constantly in mind that the two main considerations in securing good raw material from which to make butter are: (1) Obtain a good clean milk; (2) keep it free from contamination by undesirable bacteria.

THE UTENSILS.

The utensils should be of such material and construction that they are easily cleaned and kept so. The interior should be smooth, with no cracks or crevices for dirt and milk remnants to find lodgment and be removed only with difficulty. The surface should be heavily tinned and the seams filled with solder. Tinware should be kept bright and perfect. As soon as any rust spots make their appearance an entrance is given into the soft iron for germs and small particles of decaying matter, which are in consequence removed with much more difficulty. The process of cleaning vessels which have contained milk should be:

First. To rinse them thoroughly in lukewarm water.

Second. Wash thoroughly with the aid of some good soap or cleansing powder in water as hot as the hand will bear.

Third. Thoroughly rinse in hot water.

Fourth. Expose to live steam from one to two minutes or to boiling hot water for five minutes in case steam is not available.

Fifth. Exposure, if possible, in bright sunlight from two to three hours.

In this way the tinware can be kept clean and bright and free from bacteria. Having thoroughly cleaned the vessels the prevention of access of dirt to the milk in process of milking is important.

THE BARN.

The barn should be clean, light, and free from objectionable odors. In order to accomplish this remove the manure not only from the cow stall but from the barn. The cow lot should also be kept free from manure to prevent its getting on the body of the cow. The floor of the barn and stall should be capable of good drainage to insure dry floors. In addition to well-drained floors, dry, clean bedding should be kept in the stalls. Such precautions will reduce the work of keeping the body, flanks, and udder of the cows clean and will remove the greatest source of contamination. The hands and clothing of the milkers should be clean and milking done with dry hands. The filthy habit of milking with hands made wet by a stream of milk from the udder only adds to the possibility of filth being added and should never be done.

THE MILK ROOM.

The milk room should receive equal attention, with respect to cleanliness, as the barn. It should be clean, light, well ventilated, and free from objectionable odors. The separator should be cleaned each time it is used and not allowed to stand with milk in it. Flushing the separator with warm water does not remove the slime and milk constituents from the sides of the bowl. This slime is a suitable food for bacteria, and as a result of their rapid growth the contents of the bowl become a starter for the warm, fresh milk of the subsequent milking. The types of bacteria which develop here are largely those found in the manure, filth, etc., which got into the milk at the barn. These are the most undesirable kind and, their number having greatly increased in the bowl, multiply rapidly in the warm, fresh milk. Not only should the separator and its parts be kept clean, but also all equipment with which milk comes in contact.

THE STORAGE ROOM.

The storage room where milk or cream is stored or held until churned should also be clean, dry, and free from bad odors, such as those from decayed or decaying vegetables or fruit, as well as odors emanating from the kitchen when vegetables or meat are being cooked. Any or all of these odors are slowly absorbed by cream or butter and result in objectionable flavors. The damp, musty cellar is a very objectionable storage room, but when light, cool, dry, and

sweet-smelling is often very satisfactory. Whitewash, drainage, and ventilation often make an objectionable cellar a desirable storage room.

TEMPERATURES.

The temperature at which milk and cream is held previous to churning has an even more important effect than the initial number of bacteria present. These minute organisms have been found capable of reproducing themselves at the rate of once every half hour if the temperatures are favorable, but if that temperature is unfavorable their growth is checked and their number increases slowly.

MILK.

The temperature at which the milk should be held, however, depends upon the treatment it is to receive in separation. If it is to be separated by use of a centrifugal separator it should have a temperature of 90° to 92° F. and should be separated as soon after milking as possible. The longer it remains at this high temperature the greater will be the bacterial growth. On the other hand, if it is to be separated by use of some form of the gravity system it should be cooled as quickly as possible to a temperature of 50° to 40° F., which will check the growth of bacteria. The most common forms of the gravity system in use are those known as the "shallow pan" and "deep setting." The former consists in allowing the cream to set in pans (2 to 4 inches deep and 8 to 14 inches in diameter) until the butter fat has risen to the top. It can then be removed by use of a cream ladle, spoon, knife, or some other instrument. The latter, or deep-setting method, consists in the use of a tall can, commonly known as the "shotgun" or Cooley can (8 inches in diameter and 18 to 20 inches high), set in cold water. This latter method is more satisfactory than the former, since it cools the milk quicker to a lower temperature and exposes less of its surface to the atmosphere for absorption of flavors.

CREAM.

The temperature of cream that is most desirable depends upon the methods to be followed. If the cream is to be held for several days in order that a sufficient amount can be collected to justify churning the temperature should be low enough to check bacterial action and retain the cream in as sweet condition as possible until the whole lot can be ripened together. The favorable temperature in such case is 50° F., or lower if practicable. If the cream is to be ripened and the best flavors obtained a higher temperature is more favorable for the growth of the bacteria which produce those flavors. Study and

investigation of the flavors in milk, cream, and butter have shown that the best flavors are produced by the bacteria which grow at 65° to 70° F. But since this flavor is wanted only at the time cream is churned, it is most satisfactory to hold them in check by low temperatures until about 24 hours before churning time. Then raise the temperature to 65° to 70° and retain for 8 to 12 hours and gradually cool the cream to the desired churning temperature, which varies from 52° to 62° F. This temperature should be maintained from 2 to 4 hours, in order to insure proper firmness or texture in the butter. This insures in most cases a desirable flavor in the cream and butter. With the general purposes in mind it is readily apparent that cleanliness and proper temperatures are two fundamental factors in the manufacture of butter, whether it is made on the farm or in creameries.

METHODS OF CONTROLLING TEMPERATURE OF MILK AND CREAM.

It is impossible to produce a desired temperature and maintain it unless there is some accurate means of ascertaining temperatures. The only reliable method is that of using a thermometer. The accuracy and correctness of the thermometer should be unquestionable, and in order to be certain that it is, it is advisable to have the best. There are several practical methods of controlling the temperatures, but definite directions are hardly possible, inasmuch as the conditions on no two farms are identical.

These methods are:

(1) The use of cold water as a cooling agent. This may be either—
   (*a*) Cold running water from springs or deep wells.
   (*b*) Cold nonrunning water from springs or wells.
   (*c*) Water cooled by the addition of ice.
(2) The use of refrigerators or ice boxes.
(3) The use of clean, dry, cold cellars as storage room.

The following table shows very clearly the relative efficiency of cold water and the atmosphere of a cellar for reducing and maintaining low temperatures:

Method No.[1]	Temperature of cooling medium.	Temperature of cream.	Temperature of cream at later periods.								
			30 min.	1 hour.	2 hours.	3 hours.	4 hours.	5 hours.	6 hours.	7 hours.	8 hours.
	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.
1.....	62	92.5	90.5	89.0	87.0	85.0	82.0	80.5	79.0	78.0	76.5
2.....	52	89.0	86.7	83.0	76.7	73.0	70.0	68.2	67.0	65.7	65.0
3.....	52	86.5	83.8	75.6	65.1	62.5	60.5	59.0	58.0	57.0	56.1
4.....	52	85.5	77.0	68.4	63.5	60.5	58.7	57.5	56.4	55.5	55.0

[1] The methods of treatment were as follows: The can of cream was placed, in No. 1, on cement floor of the cellar; No. 2, in cold nonrunning water; No. 3, in cold running water; No. 4, in cold running water and stirred at intervals of one-half hour.

THE RIPENING OF CREAM.

By the ripening of cream is meant the changes it undergoes from the time of separation until it is added to the churn. Upon these changes depends very largely the quality of butter as regards texture and flavor. The temperature at which cream is held determines the firmness or texture, while the flavor is dependent upon the by-products from the bacterial growth.

The purpose of ripening cream is fundamentally that of giving the butter the desired flavor and aroma, but in addition it increases the ease and efficiency of churning. Cream is ripened in one of two ways:

First, it sours or ripens as a result of the action of bacteria which are normally present in milk and cream; or,

Second, it ripens as a result of action of certain kinds of bacteria which are added in what is termed a "starter."

STARTERS.

A "starter" is simply a quantity of curdled milk which has a clean acid flavor and is capable of producing a similar flavor in the cream or milk to which it is added. These starters may be made from skim milk, buttermilk, whole milk, or cream, and are used for the sake of hastening the production of a uniform desirable flavor in the ripened cream and finished butter.

These starters are of two kinds, viz, "natural" starters and "commercial" or "pure-culture" starters. A natural starter is one made by allowing the bacteria normally found in the milk to sour or curdle it. A commercial or pure-culture starter is one made by adding certain kinds of bacteria to the milk or cream and allowing it to sour or ripen as a result of their action rather than as a result of those normally present. Under natural starters we have: (1) Skim milk, (2) buttermilk, (3) whole milk, and (4) ripened cream. These are lots of milk of the kind which the name suggests that have the desired clean acid flavor and are used to hasten the production of that flavor in the cream which is to be churned. The skim-milk or whole-milk starters are made by taking a small quantity of the milk and allowing it to sour naturally, after which it is added to larger quantities of milk or cream. Buttermilk as a starter is hardly worthy of recommendation. If, however, it has a clean, desirable flavor when added to the cream it may prove beneficial.

In making the commercial or pure-culture starters pasteurized skim milk is used. Pasteurization consists in heating the milk or

cream to a temperature of 140° to 145° F. and holding for 20 minutes and then quickly cooling to 60° to 70° F. This heating destroys practically all bacteria present. After milk is pasteurized a small quantity is inoculated with a pure culture of bacteria, which increase rapidly and produce the desired flavor in the starter. These pure cultures are prepared at several commercial bacteriological laboratories and can be obtained by butter makers upon order.

The advantages to be derived from use of starters are: (1) It favors the production of a good uniform flavor and aroma in butter; (2) it hastens ripening; and (3) it enables the butter maker to more readily control the quality of his butter.

The temperatures which favor the growth of bacteria during the ripening of cream are 65° to 70° F. The bacteria which produce the most desirable flavors grow best at or above these temperatures, while those which increase and act at lower temperatures are less desirable. It should be the object of every butter maker to produce a clean acid flavor in the cream and to churn when this flavor has been attained, so that it may be absorbed by the fat and be present in the finished butter.

METHODS OF DETERMINING THE RIPENESS OF CREAM.

In the making of butter it is essential that the ripening of the cream be controlled and that an accurate method of determining the proper degree of ripeness, with respect to flavor and aroma, should be understood and applied by the farm butter maker. There are at present several methods of determining the percentage of acidity in cream. This acidity, however, is only an indicator of the flavor and aroma and must be supplemented by the sense of taste and smell. Cream will become stale and yeasty in flavor without any very great increase in acidity after a certain stage is reached. This seems to be often the case in cream from which dairy butter is made. The most common and probably the most practical method of determining the ripeness of cream is by taste and smell. The flavor should be clean, rich, and free from anything objectionable. If the flavor is once well understood and recognized the butter maker can with some degree of accuracy maintain it, if intelligent efforts are made. Another very common practice is to judge by the appearance of the cream. When thoroughly ripe it thickens slightly and takes on more or less of a glossy appearance. These two methods are common among farm butter makers. Among creameries another method known as the "acid test" is very generally in use. This consists in determining the per cent of acid present in the ripened cream. Experience has shown that cream containing 0.4 to 0.5 per cent of acid has ripened sufficiently to produce the desired flavors and aromas.

This test is made by the use of an alkaline solution and an indicator. It is made in the following way: A definite amount of cream is taken in a glass or cup with white interior. To this cream a few drops of the indicator are added. The alkaline solution is then slowly added to the cream until a permanent slight pink color appears. The indicator, which is colorless in presence of an acid and a deep pink or red in presence of an alkali, serves to show when all acid has been neutralized. The alkaline solution is of a known strength and the cream of known quantity. With these two factors it is possible to quickly calculate the percentage of acid. Apparatus and solutions necessary, along with directions for making the test, can be secured from practically all dairy supply houses.

During the ripening the cream should be stirred thoroughly and frequently. This insures uniformity and prevents the butter fat separating from the milk constituents of the cream. It was mentioned previously that bacteria do not act upon the butter fat, but upon the other constituents. If the butter fat rises to the top of the cream, as it will if not stirred, the flavor and aroma will not be uniformly absorbed. The milk or lighter cream in the lower part of the vat or cream can will sour more quickly, curdle, and probably result in white specks of curd being incorporated in the butter. To prevent this and insure uniform ripening, cream should be stirred. Cream should be run through wire strainers to remove and break up curd particles.

COLORING THE BUTTER.

The uniformity in appearance and attractiveness of butter is greatly increased by the color. The most desired color is that usually found in butter produced in June, when cows are having large amounts of green, succulent feed. Butter makers endeavor to maintain a uniform color throughout the year by the use of "butter coloring." The amount of color varies with the season, but is usually at the rate of from one-half to 1½ ounces of color for each 25 pounds of butter, which is about one-half to 1½ teaspoonfuls for each 3 pounds of butter. This color should be added to the cream just after cream has been put in the churn and before churning has begun.

CHURNING.

Churning is a process of removing butter fat, which exists in minute globules, from milk or cream. This is accomplished by agitating the cream thoroughly, thereby causing the fat globules to come into contact with each other and cohere as a result of concussion. The composition of cream affects the ease of churning. It is composed, as we know, of butter fat and milk serum. The percent-

age of butter fat affects the proximity to each other of the fat globules which exist in suspension in the serum of milk and cream. Globules are much nearer each other in cream than in milk and nearer each other in 40 per cent cream than in 15 per cent cream. The effect of temperature upon these minute fat globules is to harden or soften them, just as it does lard, tallow, and other fats. A low temperature hardens them; a higher causes them to become soft. The ease or readiness with which they adhere to each other upon coming in contact is dependent upon their softness. If they are too firm they do not adhere readily.

With these few facts in mind, it is well to note the most important factors which influence the process of churning. These factors are:

(1) The per cent of butter fat in cream.
(2) The temperature of the cream.
(3) Fullness of the churn.
(4) Speed of the churn.
(5) Breed of cows.
(6) Individuality of cows.
(7) Time in the period of lactation.
(8) The feed of cows.
(9) Acidity of cream.

A brief discussion of these factors will bring out more clearly the effect of each.

(1) As noted above, the percentage of butter fat determines the proximity of the fat globules to each other and affects the chances of their coming into contact during the churning or agitation of the cream.

(2) The temperature of these fat globules determines their softness and the ease with which they adhere and form the small granules. These unite with others until they become visible in granules as large as wheat and corn kernels.

(3) The fullness of the churn affects the amount of agitation which is possible during the revolution of the churn. If the amount of cream is small it may adhere to the walls of the churn and receive little or no agitation. On the other hand, if the amount is too large the churn will be so full that very little room will be left for the agitation and concussion.

(4) The speed of the churn also affects the amount of agitation the cream receives. If it is revolved too rapidly the centrifugal force is sufficient to cause the cream to remain in one end without causing agitation. If it is revolved too slowly the cream flows from one end of the churn to the other and does not receive agitation or concussion.

(5) The size of fat globules in milk varies according to the breed.

The larger these globules the more quickly and easily they unite. Hence their effect on the time required for churning.

(6) The production of large and small fat globules varies in individual cows. Some produce a larger percentage of large fat globules than others. Hence the churning time is affected by the individuality of the cow.

(7) The stage in the period of lactation is also an influencing factor because of its effect on the size of the fat globules and for other reasons not yet fully understood. In the earlier part of the milking period cows produce milk containing larger fat globules than they do during the latter months.

(8) The effect of feed upon churning is due to its effect upon the composition of the fat globules. It is generally conceded that a green succulent feed, like grass, green corn, ensilage, etc., tends to increase the softness of the fat globules, while a dry feed, such as grain and hay, causes a harder butter fat.

(9) The acidity of cream probably affects the time and completeness or efficiency of churning. The ripened cream will probably churn in less time and more efficiently than sweet cream; hence, if it is necessary to churn quantities of cream which have been collected from day to day, as is almost universally true in farm butter making, they should be mixed together a few hours before churning in order that the acidity will be uniform throughout the whole quantity.

While all these factors affect the time and labor required for churning, the most important ones are the percentage of fat in cream, the temperature of the cream, and the fullness and speed of churn. If these four factors are carefully controlled, little difficulty in churning will be experienced. The cream for churning should contain at least 25 per cent butter fat, should be at such a temperature that it will churn in 25 to 30 minutes, giving a firm, granular butter, and should be sufficient in quantity to fill the barrel churn between one-third and one-half full. The churn should be revolved so as to give the greatest agitation and concussion possible.

THE OBJECT OF CHURNING.

In churning, the butter fat globules should be massed into granules in order that it can be more easily separated from the other milk constituents. The separation of this butter fat with ease and efficiency makes churning one of the most important steps in the production of butter either in creameries or on farms. The degree or amount of churning is dependent upon the size of granules desired. This varies in practice, but if the purpose in having them a definite size is thoroughly understood the efforts at controlling their size can be more intelligently made. The purpose or object in controlling

the size of the butter granules during churning is threefold: (1) Removal of buttermilk; (2) more even distribution of salt; and (3) finer grain or texture.

The buttermilk can be most thoroughly removed if butter is in the form of granules varying in size from that of corn kernels to peas. The massing of butter into lumps as large as a walnut or a man's fist results in the incorporation of buttermilk and makes removal by washing very improbable. Again, if butter is in small granules the salt can be more easily distributed and the butter be more uniformly salted. The amount of working necessary is reduced and results in a finer grain and texture. If the butter is in one mass when the salt is added the working necessary to distribute the salt will usually injure the body. The size of the granules can be controlled by stopping the churn frequently after the butter breaks. The churn should be stopped when butter is in granules as large as corn kernels or peas.

WASHING THE BUTTER.

After the churning has been completed the buttermilk should be drawn off through a fine-meshed strainer to prevent loss of small particles of butter. When the buttermilk has been removed the butter should be washed with cold water which is a few degrees colder or warmer than the buttermilk was. This temperature depends upon the butter. If it is too soft use colder water; if too firm use warmer water. The reasons for washing butter are three: (1) To remove the greater part of the buttermilk, and in many cases to improve the flavor; (2) to improve the keeping quality; (3) to "firm" or harden the butter so that it can be more easily handled and neatly packed. The method of washing depends somewhat upon the kind of churn in use, but the primary object is the same, viz, removal of the buttermilk. In a barrel churn, if an amount of water equal to that of the buttermilk is used, 8 to 12 revolutions is generally sufficient to remove the buttermilk. When washing is completed the butter should still be in the granular condition.

SALTING THE BUTTER.

After drawing off the wash water the granular butter should be salted. The amount of salt necessary varies. If the reasons for salting are kept in mind the amount necessary can be readily determined. There are three reasons for salting: (1) Improvement of the flavor; (2) satisfying market demands; (3) serves more or less as a preservative.

There are several methods in use among butter makers for determining the amount of salt to be added to butter. In creameries salt

is usually calculated upon the butter-fat basis, i. e., from the weight of cream and percentage of butter fat the pounds of butter fat are calculated, and for each pound of butter fat a definite amount of salt is added. This amount varies from one-half ounce to 1½ ounces per pound, dependent upon demands of the market. In the larger dairies, where from 50 to 500 pounds are made per week, probably the most common method is to weigh the granular butter after washing has been completed, and add a definite amount of salt for each pound of butter. This amount varies in different localities from one-half ounce to 1½ ounces per pound. When this practice is followed the salt should be sifted evenly over the granular butter by use of a fine-meshed sieve. This prevents the addition of lumps of salt, which would be dissolved and distributed with difficulty.

In the small farm dairies, where from 5 to 10 pounds are made per week, it is usually the practice to estimate the weight of butter and guess at the amount of salt necessary. This practice is not to be recommended on account of the great lack of uniformity in salting which results. Either the practice followed in creameries or the larger dairies should be used. Weighing both the butter and salt is probably the more practical.

WORKING THE BUTTER.

After the addition of the salt the butter should be worked. The purposes of working are: (1) To distribute the salt; (2) to produce a compact, firm, close-textured body; (3) to expel moisture and buttermilk.

The amount of working necessary to distribute the salt depends upon the granular condition of the butter and salt. If the butter is in lumps or is very firm more working is required than if butter is in small granules. If the salt is not well pulverized and fine grained it is hard to dissolve and distribute. It dissolves and is distributed more easily in a fairly soft butter than in a very firm, hard butter.

The desired body is also dependent upon the granular condition and firmness of the butter. When the granules are small and very firm working requires more effort. When they are too soft the butter requires less working, but is very likely to be lacking in texture, i. e., without a granular appearance, when the broken surface is examined.

Three points should be observed in determining whether butter is worked sufficiently: (1) It should present a firm, glossy appearance; (2) the texture, especially at later examinations, should resemble the granular structure of broken end of steel rod; (3) there should be no grittiness due to the unevenly distributed or undissolved salt. This

can be determined by taking a small piece of butter between the teeth and biting into it repeatedly. Any grittiness will soon be observed.

Insufficient working is generally shown by a mottled appearance in color on the cut surface. This is largely due to an uneven distribution of salt. Overworking is usually shown by a poor grain or texture. This results in a salvy condition and injures the keeping quality. The aim of butter makers should be to produce a high-grade article that is uniform week after week in flavor and composition. This can be done by careful methods in ripening, salting, and working.

PRINTING AND PACKING BUTTER.

The printing and packing of butter is the first and fundamental step in getting it on the market or before the consumer, and should be given careful attention. The greatest lack of uniformity in farm butter is probably that apparent in package or printing. The objects to be attained are: (1) Convenience in handling; (2) attractiveness for the consumer; (3) source of advertising to the producer.

Success in making the butter attractive, convenient to handle, and an advertisement in itself will make profit more probable if care be taken in the production of a good quality of butter. With such attributes butter can usually be profitably marketed.

The packages now in use among farmers are crocks, fiber boxes, parchment papers and cartons, dishes, buckets, pans, etc. The use of some of these packages make attractiveness and convenience impossible. The most desirable and attractive forms of packages are the 3, 5, or 10 pound earthen crocks and the 1 or 2 pound prints wrapped in parchment papers. These wrapped prints are in some cases inclosed in pasteboard cartons or boxes. The name and address of the producer and a brief statement concerning the butter is usually printed upon the paper or carton. This serves as an advertisement and makes a trade-mark possible whereby the public may know what to call for and know whether the butter received is the butter that was asked for. This should lead to an increased demand for that particular product.

MARKETING THE BUTTER.

The original and ultimate object in the production of farm butter, as in any other product, should be production at a profit. This profit, being dependent upon the marketing, should make the efforts toward securing a suitable market greater than is usually the case. The objects to be gained in marketing are: (1) Patrons who appreciate and are willing to pay for a butter superior in quality and

appearance; (2) a constant steady market; (3) satisfied customers, which will result in an increased demand.

With these points in mind it is well to state the kinds of market that are available and which are being profitably taken advantage of in different sections of the United States. These are classed as follows: (1) Private customers, e. g., individuals, hotels, and restaurants; (2) selected grocery stores; (3) summer hotels in certain localities; (4) commission houses in nearby cities.

DAIRY EQUIPMENT.

Up to this point little has been said about the kinds of utensils and equipment necessary for manufacture of butter on the farm. The fact that utensils and equipment are not the fundamental factors has led to the delay in their discussion. Excellent butter is in many cases made by the use of the most antiquated and crude equipment. The quality of the butter is dependent upon the intelligent use of rather than the kind of equipment. The convenience and desire to save time and labor should, however, be sufficient to induce butter makers to endeavor to get the most suitable equipment that the market affords. The improvement and time saved due to intelligent use of the most suitable dairy equipment will result in a profit and satisfaction that is not possible with the antiquated equipment of our forefathers.

The dairy equipment should consist of:

Apparatus for determining percentage of fat in milk and cream. (Babcock tester, bottles, milk-record sheets, etc.)
Some means of heating water—a boiler.
Milk pails.
Hand and floor brushes.
Milk strainer.
Cream separator.
Milk cans.
Floating dairy thermometer.
Cream-ripening vat.
Tank for cold water (used in maintaining low temperatures of milk and cream).
Cream stirrer.
Cream strainer.
Barrel churn.
Butter worker.
Butter ladles.
Scales or spring balance.
Butter printer.

Parchment paper or other butter packages.
Butter delivery box.

While all of this equipment is not absolutely necessary, it can be used to advantage. The needs of the individual dairy will determine which can be best omitted. A brief discussion of the construction and purpose of each, accompanied by illustrations, may be serviceable:

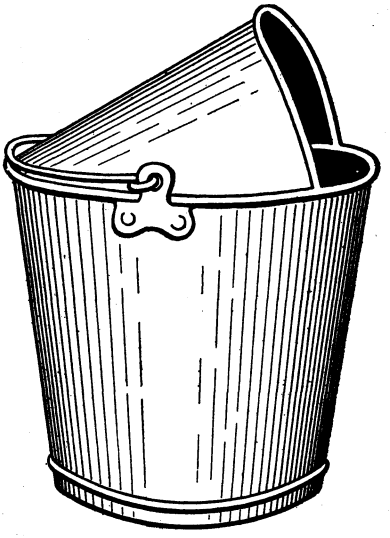

FIG. 1.—Covered milk pail.

Milk pails should be of such construction as to enable them to be easily cleaned and kept bright. This is best accomplished by having the inner surface of the pail smooth and free from seams or crevices which serve as a place for dirt to accumulate and make its removal difficult. The pails should have the seams smoothly soldered and should be heavily tinned to prevent rusting. They should have a narrow or covered top to exclude as much falling dirt as possible. (See fig. 1.)

Brushes should be used in cleaning the pails and other utensils about the dairy. They are much more efficient, convenient, and easily cleaned than dishcloths. The pails should be thoroughly cleaned after each usage by first rinsing with warm water, using a stiff ox-fiber brush and some cleansing powder to remove any particles of dried milk or other substances which would be deleterious to milk that was later drawn into them. After this brushing and cleaning with warm water the pail should be rinsed with boiling or scalding water. The heat imparted in this way will be sufficient to dry the pail and destroy the bacteria which are present, thus leaving the pail clean for subsequent usage. Floors of dairy room should be kept clean. The floor brushes in use are very efficient for this purpose (see fig. 2).

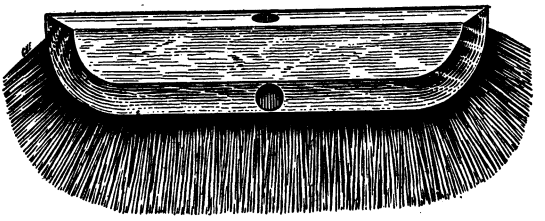

FIG. 2.—Floor brush.

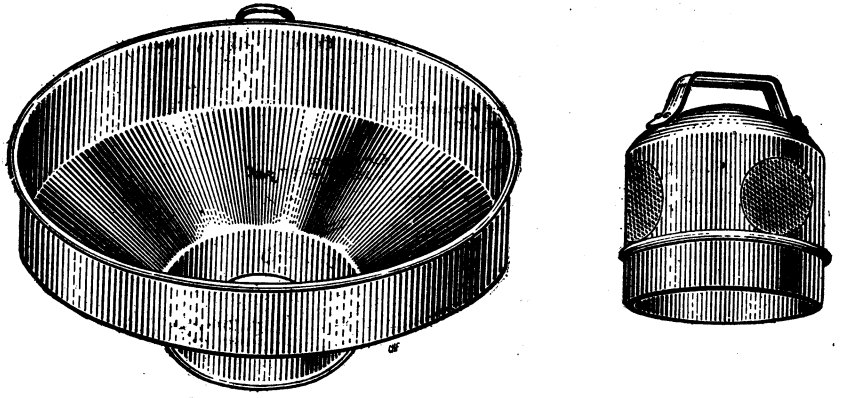

FIG. 3.—Milk strainer, showing center removed.

FIG. 4.—Floating dairy thermometer.

The milk strainer should be of the size most suitable for the dairy. The strainer part should be of wire gauze having a small mesh to remove as much of the dirt particles as possible. It should be cleaned in the same manner as the pails and kept sweet by scalding. The body should be smooth and free from seams (see fig. 3).

The cream separator.—The points to be considered in a separator are: (1) Ease of operation, (2) efficiency, (3) durability, (4) capacity, (5) height of feed can from the floor, and (6) ease of cleaning. These requirements are met by most of the standard make of machines.

Milk cans.—The size of cans necessary is dependent upon the quantity of milk to be handled. The cans most frequently used are known as the 3-gallon or "shotgun" can, and the 5 or 8 gallon cans. They should possess the same characteristics so desirable in milk pails, viz, smooth, heavily-tinned interior, to prevent rusting and difficulty in cleaning.

Floating dairy thermometer.—A thermometer should be intelligently used by every butter maker. The control of temperatures is one of the most important parts of dairy work, and can be done more efficiently if definite knowledge is obtainable. The floating dairy thermometer, which is very convenient, makes this knowledge possible. It should be accurate and reliable. Such a thermometer is easily cleaned (see fig. 4).

Cream ripening vat.—The ripening vats used in some of the larger dairies are very convenient and efficient. The vat

is surrounded by a wooden box which leaves space for a water-jacket. This jacket or space is kept filled with cold water, which serves to

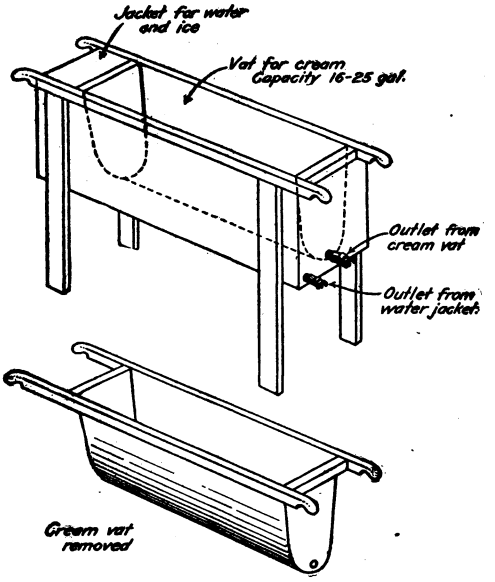

FIG. 5.—Cream ripening vat.

cool and control the temperature of cream during the period in which it is collected and ripened. Cream can be warmed or cooled by filling this compartment with warm or cold water. (Fig. 5.)

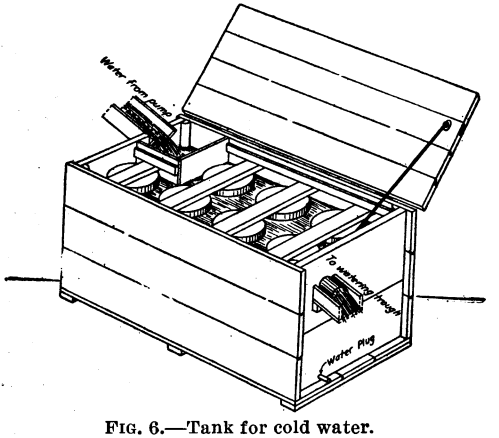

FIG. 6.—Tank for cold water.

A tank for cold water will serve the same purpose and can be used in maintaining low temperatures of milk and cream. Such a tank is very commonly used among farmers, with very good results. The

milk or cream in the Cooley or "shotgun" can (8 inches in diameter and 20 inches deep) is set in the tank of cold water (figs. 6 and 7).[1]

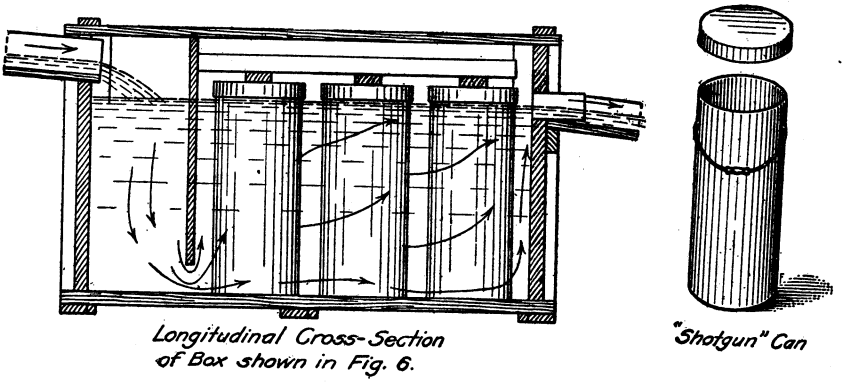

FIG. 7.—Tank for cold water.

The cream stirrer may be of any form. It should be used frequently. The object of stirring cream is to keep the fat and other cream constitutents thoroughly mixed, so that the ripening may be uniform and no large curd particles will form and later appear in the butter as white specks. This thorough mixing will make the absorption of flavors and aromas by the butter fat more uniform. One type of stirrer is shown in figure 8.

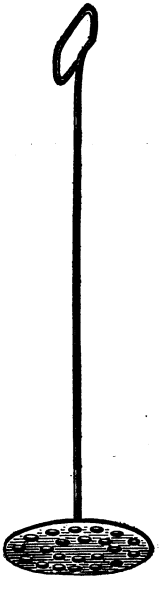

FIG. 8.—Cream stirrer.

A cream strainer should be used when cream is being added to the churn. Straining at this time through a somewhat larger meshed gauze will break up any curd particles which may have been formed and reduce the probability of white specks appearing in the butter (see fig. 9).

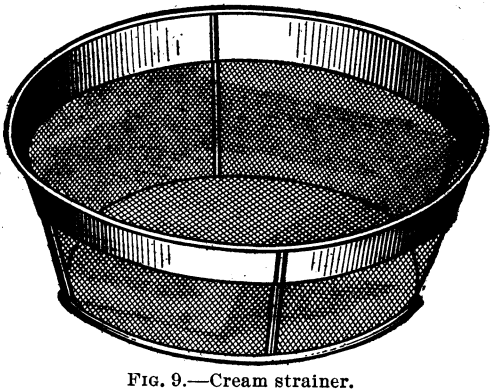

FIG. 9.—Cream strainer.

[1] Illustration from Bul. 17. Dairy and Cold Storage Commissioner's series. Canada.

A barrel churn is generally recognized as the most convenient and efficient kind in use. The absence of inside fixtures makes the operation and cleaning easy. The churning is due to agitation and con-

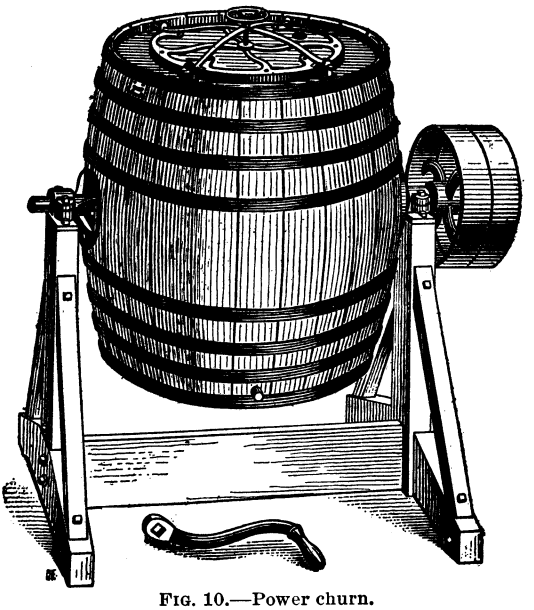

FIG. 10.—Power churn.

cussion, which is not likely to injure or destroy the granular structure so desirable in butter. These churns may be operated either by hand or some mechanical power. The use of a pulley instead of a crank

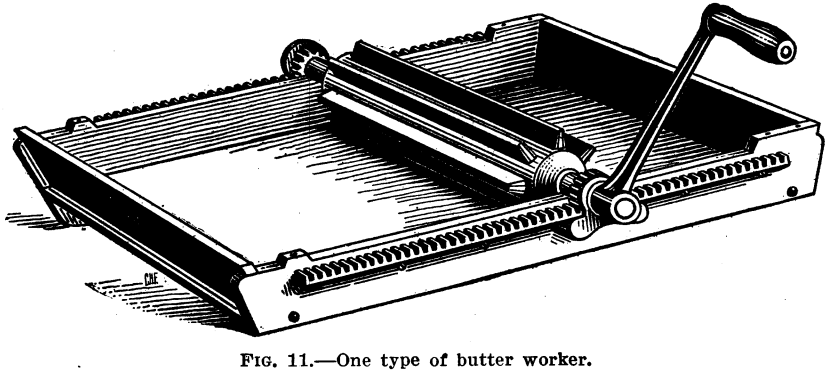

FIG. 11.—One type of butter worker.

makes it possible to transfer power by means of a belt from other machines, such as gasoline engines, electric motors, treadmills, windmills, etc. The farm separator may also be operated by the same power (see fig. 10).

The butterworker should be easy to operate, convenient, and efficient. In working, the salt should be distributed and the butter worked into a firm, close-grained mass without injuring the texture. This

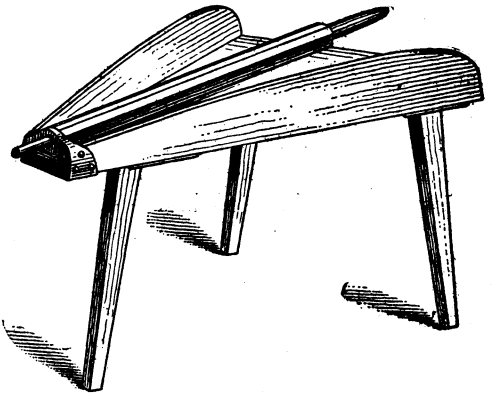

FIG. 12.—Lever butter worker.

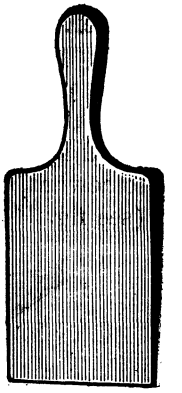

FIG. 13.—Wooden ladle.

seems to be most easily accomplished by use of a worker having a corrugated roller which is passed backward and forward over the butter. This distributes and works in the salt without injuring the

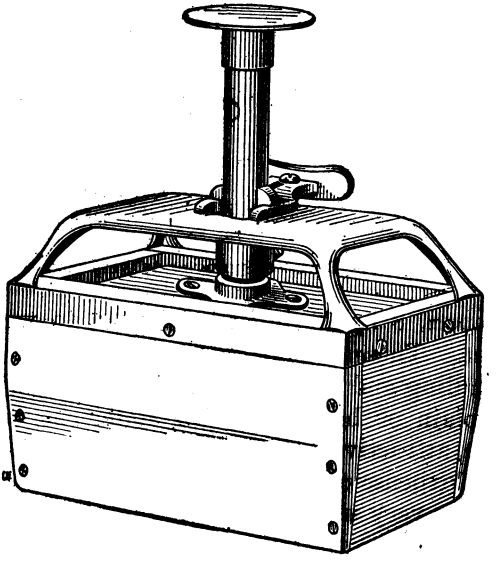

FIG. 14.—One-pound Butter printer.

grain or body. The butter can be more uniformly worked and with greater ease than with some of the other workers (see figs. 11 and 12).

Butter ladles.—Butter should not be touched or handled with the

bare hand. The heat of the hand injures the body of the butter and in addition is very insanitary. The consumers of butter object to eating butter with finger prints upon it. Wooden ladles, as shown in figure 13, are very satisfactory.

Scales for weighing the butter and salt should be used by every butter maker. Their use insures greater uniformity in salting and adds greatly to the satisfaction of knowing what is being done.

The butter printer enables the butter maker to put the butter up in a uniform, neat package from week to week. The most popular, convenient, and attractive form is that of the 1-pound print. The form varies somewhat, but the most commonly used is one $4\frac{5}{8}$ by $2\frac{1}{2}$ by $2\frac{3}{8}$ inches (see fig. 14).

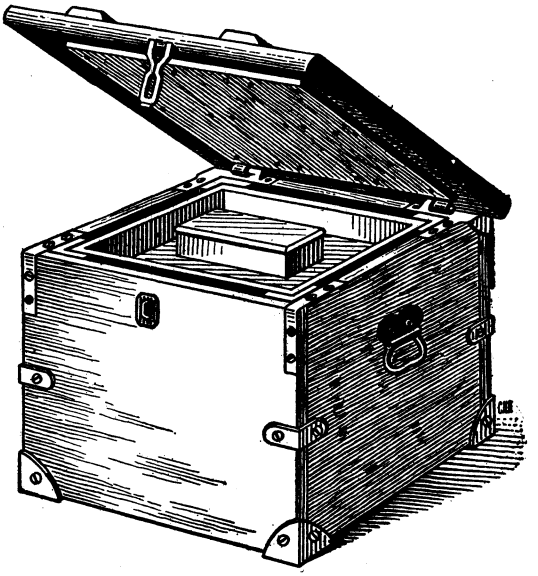

FIG. 15.—Butter shipping or delivery box.

Parchment papers, 8 by 11 inches, are used to wrap these pound prints of butter. These papers protect the butter from dust and dirt during handling and are also used in showing who the maker is. They may be plain or bear a printed statement or advertisement. The convenience, attractiveness, and protection are sufficient to justify the slight added expense of their use.

A delivery box is very useful and necessary in handling butter. It should be constructed so the butter may be kept cool and in a firm condition throughout the time necessary for delivery. This can be done by having a deep rectangular can of crushed ice in the central part of the box. The pound prints can be placed around this and

kept from becoming soft and difficult to handle. The use of ice throughout the process of making and marketing butter should be more common (see fig. 15).

CONCLUSIONS.

In conclusion, it may be well to add a few brief instructions:

(1) Keep good cows that will produce from 200 to 300 pounds or more of butter fat annually.

(2) Feed them liberally; follow methods commonly employed among feeders in the cow-testing associations.

(3) Keep the cows comfortable and clean when in the stable. Comfort is conducive to best production.

(4) Skim a rich heavy cream of not less than 25 per cent fat. The fat can be regulated by adjusting the cream screw.

(5) Keep an accurate, reliable thermometer at hand and use it intelligently.

(6) Keep the cream cool. It should be as near 50° F. as possible, if it is desirable to keep it sweet and check bacterial action.

(7) Cream should be ripened before churned; 65° to 70° F. favors the growth of the bacteria which produce desirable flavors in cream. The number of desirable bacteria can be increased by the use of "starters." Cream should not be ripened for too long a period. It soon develops objectionable flavors. Stir the cream frequently during ripening to insure uniformity. Strain the cream through wire-gauze strainer to break up or remove the curd particles.

(8) Churn at a temperature that will give a firm, flaky granule in the butter. This temperature varies slightly with the season, but ranges from 52° to 62° F. The use of a thermometer and intelligent observation, as result of a few churnings, will enable the butter maker to determine the proper temperature at which to churn. Churn should be stopped when butter granules are large as corn kernels or peas. Time required for churning should be 25 to 30 minutes.

(9) Use clear, pure water for washing the butter. It should not be more than 3° colder or warmer than the buttermilk. Use amount of water equal to that of buttermilk. In barrel churn revolve 12 to 15 times in washing.

(10) Weigh the granular washed butter and salt at the rate of three-fourths ounce to 1 ounce per pound. Be sure the salt is well pulverized and sift it evenly over the granular butter before any of the moisture is worked out.

(11) Work the butter sufficiently to distribute salt without injuring the grain or texture. Determine working by (1) appearance, (2) texture, (3) grittiness.

(12 Put the butter up in clean, neat, attractive packages.

(13) Keep everything in and about the dairy clean and attractive.

(14) Make earnest and conscientious efforts to obtain and retain profitable markets.

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